SCIENCE

VOL. LXXI — FRIDAY, APRIL 25, 1930 — No. 1843

International Cooperation in Geographical Work: DR. WILLIAM BOWIE 425

Obituary:
Arthur McQuiston Miller Memorial Services; Memorials; Recent Deaths 429

Scientific Events:
A Chemistry House in London; A Scientific Advisory Board for the Westinghouse Research Laboratories; The Twenty-fifth Anniversary of the Illinois State Geological Survey; The American Philosophical Society 430

Scientific Notes and News 432

Discussion:
The Future of Taxonomy: DR. CLARENCE E. MICKEL. *Pressure Potential in a Fluid:* DR. W. H. PIELEMEIER. *Conglomerite, A New Rock Term:* PROFESSOR BRADFORD WILLARD. *Banana Stowaways Again:* DR. ROBERT K. ENDERS. *When Believing is Seeing—an Optical Illusion:* RUTH FULLER STEVENS 436

Reports:
The Western Cooperative Oil Spray Project: R. H. ROBINSON, D. F. FISHER, ANTHONY SPULER 440

Scientific Apparatus and Laboratory Methods:
Sedimentation Tube for Mechanical Analyses: DR. PARKER D. TRASK. *Stock Cultures of Ameba:* DR. H. W. CHALKLEY 441

Special Articles:
The Chemical Control of Splenic Contraction: PROFESSOR J. M. D. OLMSTED and DR. S. F. COOK. *The Chemical Nature of Cypridina luciferin:* DR. SAKYO KANDA 442

Science News x

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. — Garrison, N. Y.

Annual Subscription, $6.00 — Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

INTERNATIONAL COOPERATION IN GEOGRAPHICAL WORK[1]

By Dr. WILLIAM BOWIE

U. S. COAST AND GEODETIC SURVEY

IN my capacity as a delegate from the United States I am representing the National Geographic Society of Washington, D. C., as well as the Department of Commerce of the United States government.

The officials of the National Geographic Society requested me to extend to this assembly their most cordial greetings and their best wishes for a bright and distinguished career for this institute which we are now bringing into existence.

The officials of the National Geographic Society are deeply interested in all phases of geographical science. They have done much to bring the nations of the world into closer touch with each other by the dissemination of accurate geographical information supplemented by a remarkable series of pictures in their splendid *National Geographic Magazine* that is known to every educated man in the world. The officials have expressed to me the hope that they may have very close contact with the officials of the Pan-American Institute of Geography and History in order that the science of geography may be carried even further than it has been in the past.

They expressed the hope that the government agencies of the various American nations which are engaged in any phase of geographical science will receive the support of those officials of the government who have to do with the allotment of funds for these official geographical services. They also expressed the hope that non-official agencies, such as geographical societies or geographical departments of universities, may be stimulated by the organization of the Pan-American Institute of Geography and History to

[1] Address delivered before the Pan-American Institute of Geography and History, meeting in Mexico City, September 17, 1929.

carry on their operations on a wider and grander scale than may have been the case in the past.

The officials of the National Geographic Society are not unmindful of the fact that this institute is to cover history as well as geography. In fact, they realize that there is a close association between historical research and the geographical environment of those regions for which the historical studies are undertaken. It is, in fact, impossible to divorce geography from history. The historian can not properly discover or interpret the motives that impelled large or small groups of people to act in a certain way unless he knows the geographical conditions which prevailed at the time such action was taken. Surely the character of the climate and of the terrain, as well as the presence or absence of rivers and streams or ocean fronts, has tremendous bearing on the development of the civilization of a tribe or a nation.

However, my ability to discuss history in its broad and technical phases is limited, and I will leave to our delegates who are historians the task of properly setting forth the place that historical research will have in our new institute.

The officials of the National Geographic Society wish me to convey to you their earnest desire that the efforts of the people in the western hemisphere, acting under the leadership of our institute, should be successful in discovering the historical facts and in setting them forth in books or papers in order that the data secured may be used for the purpose of making the life of the dweller in the western hemisphere fuller and richer. With knowledge comes power, and with power we have the means of raising the scale of living and increasing the happiness of the citizens of each of the American nations.

We have heard much in recent decades of the application of scientific principles to agriculture and other great industries, in exchange of goods and in communication. But science can only go a certain distance towards bettering the condition of humanity and making civilization grander and nobler without having geographical facts. It is here that the geographer must supplement the work of the physicist, the chemist and the engineer, for without the geographical information and background the other sciences can not well be efficiently employed in the utilization of the resources which nature has given abundantly to the nations of the world.

The officials of the National Geographic Society have expressed frequently, and do on this occasion through me, their opinion that civilization will be greatly advanced by an early completion of the mapping of the world. We are all familiar with the sheet of paper on which are drawn the margins of the continents which are equally the limits of tidal waters. How frequently these maps are totally inadequate to convey accurate information as to the geographical locations of points within the country, their elevations, the accurate location of mountain ranges, rivers, streams and highways, nor do they show the slope of the ground. Without all these essential geographical data the map user can not form accurate and detailed pictures of the conditions within the area covered by the map.

On the other hand, there are in existence for certain portions of the area of each country topographical maps which do carry these essential data. The officials of the society would like to see the day when there is an adequate topographical map covering the area of each of the countries in the western hemisphere. Much mapping has been done in my country, but only 44 per cent. of its area has as yet been topographically surveyed, and many of the map sheets are inadequate, owing to age or deficient methods employed in the survey, to meet the needs of agriculture, mining, the development of hydroelectric power and extension of transportation systems and systems for the transmission of power and communication.

The engineers and other leaders in industry are making their wants known in regard to topographic mapping, and it is practically certain that within the next few years each country of the world which is not already supplied with topographic maps will increase its activity in the mapping line. It has truly been said that only a rich nation can afford to develop its natural resources and its industries without previously having executed the topographic surveying and mapping.

I have expressed to you the opinions and wishes of the officials of the National Geographic Society, and I hope I have made it clear that they wish to help the Pan-American Institute of Geography and History in every way that is possible for them and that they stand ready to cooperate with the institute and the geographical services of the American countries in developing the western hemisphere in the interests and the welfare of humanity.

The western hemisphere is new to civilized man. It is less than 450 years since Columbus discovered the new world and opened up a vast area which was destined to have such a great influence on the development of civilization. We, in this generation, have a great responsibility thrust upon us. We must hand down to posterity our countries with their natural resources. If we are wise we will develop and utilize these resources for our present needs, but we will do so in such a way that we shall not impoverish those generations which are to follow us. In this development and utilization the geographer should

and must play a leading and important rôle. It is here that the Pan-American Institute of Geography and History can exert a great influence for good by outlining geographical problems that should be attacked and solved and in disseminating geographical principles and data which may have been discovered. A fact is of no value if locked in the mind of a single geographer. It is useful only when he has published the results of his investigation and research in order that every one may have the benefits of his work.

I am sure you will be interested in knowing more intimately the National Geographic Society and the scope of its activities. It is organized on the democratic principle that each of its 1,200,000 members has a share in supporting the magazine that it publishes and the exploration work to which it has given financial support. Also the membership supports financially the various lines of educational work which are carried on by the society.

Each member is, on the other hand, entitled to know just what have been the results of the explorations that have been conducted under the society's auspices. He must be kept informed of changed geographical positions which may occur in widely separated parts of the world. He is entitled to have the maps which are compiled and printed by the society and he is also entitled to the results of the world-wide photographic survey of matters of geographical interest which the staff of photographers of the society is making.

All these data are furnished to every member through the society's *National Geographic Magazine* and in special technical publications which are issued from time to time and give the results of geographical explorations.

The society is independent of governmental control. It is a private institution and receives no funds from the government of our country. However, it cooperates with governmental agencies which are carrying on geographical research or investigations, and it from time to time will finance a project which may be advocated by a government official who has not at hand governmental funds for carrying on work. There are two notable examples of this. First, the exploration of the Carlsbad Caverns in New Mexico by the late Dr. Willis T. Lee, who was a member of the U. S. Geological Survey. Another was a reconnaissance survey of the active and extinct volcanoes along the Alaskan Peninsula and the Aleutian Islands by Dr. Thomas A. Jaggar, also a member of the U. S. Geological Survey.

The society has done a noteworthy service to science in disclosing the history and art treasures of pre-Columbian civilization both in North and South America.

Seven expeditions of the society to Chaco Canyon, under the leadership of Neil M. Judd, unearthed and explored the remains of America's finest prehistoric communal dwellings. One of these pre-Columbian "apartments," Pueblo Bonito, housed some 1,500 people, had 350 rooms on the ground floor and yielded an amazing array of utensils, art objects, ceremonial appurtenances and other evidences of their daily life.

You are familiar with the Pedregal area, south of Mexico City, with its mass of unweathered lava from the volcano Xitli. Beneath that "Stony Place" is a blanket of soil, and underlying the soil is another lava flow of the remote past. There an expedition of the society led by Dr. Byron Cumming found encased remains of a people who flourished at a period variously estimated at from 3,000 to 6,000 years ago. Clay images, bone awls, ear ornaments and other objects of this earliest known American civilization, which flourished in your country, are seen by thousands of the National Geographic Society's members when they visit its headquarters in Washington, D. C.

Dr. Ernest G. Holt is now leading one of the society's expeditions which is exploring the haunts of birds in the southern parts of Venezuela. Bird life is the principal objective, but observations of the terrain, the animals and other life forms and the amazing variety of tropical plants are being made.

The National Geographic Society has a research committee whose chairman is now Dr. F. V. Coville, botanist of the Department of Agriculture of the federal government. This committee investigates carefully every project for which financial assistance is asked. There have been many cases where the committee has recommended and the trustees have made grants of funds for worthy projects. The most recent one was the appropriation of $50,000 from its research fund and the assignment of certain scientific personnel for the expedition of Commander Byrd to the Antarctic Continent.

Somewhat earlier it supported financially Admiral Peary's expeditions to the Arctic regions. It contributed financial aid and scientific guidance to the Wellman Polar Expedition, which went to Franz Josef Land in 1898 and made biological and geological collections and in addition observed atmospheric temperatures and other conditions. The data collected were of high scientific value and also an aid to later explorers in that region.

A technical representative was detailed by the society to accompany the Ziegler polar expedition of 1903–05 to direct the scientific work. In 1925 it sent out an expedition to northern Greenland and Ellsmere Island during which Commander Richard E. Byrd gained his first flying experience in polar regions.

One of the most notable pieces of geographical work done by the National Geographic Society was in the Mount Katmai region in Alaska. As is well known, that mountain erupted in 1912, and the ashes from the eruption covered a wide area. The primary purpose of the studies undertaken by the society was observation of the rejuvenescence of the flora which had been obliterated. The exploration party to Mount Katmai observed that the eruption had left a crater almost as large as the one in Vesuvius. When they crossed the mountains towards Bering Sea they discovered a vast area from which were rising innumerable columns of steam. This area, which was investigated intensively by four subsequent expeditions under the direction of Dr. Robert F. Griggs, was called the Valley of Ten Thousand Smokes. The funds necessary to finance these expeditions all came from the treasury of the National Geographic Society. Accounts of these explorations at Katmai have been published in the magazine of the National Geographic Society and also in a series of technical papers.

It would take too much time to tell you of each of the explorations or pieces of geographical research that have been carried on by the society or financed from its treasury, but what I have told you is, I am sure, sufficient to convince you of its high standing, and of the vast scope of its activities. It will, I am sure, encourage you to know that this great organization, through its officials, has expressed such deep interest in the future of the Pan-American Institute of Geography and History. The society is an ally that the institute will be glad to welcome in its efforts to advance geographical science and knowledge in the western hemisphere.

The officials of the National Geographic Society are thoroughly convinced that geographical information, if properly prepared and disseminated, should be as interesting to the child as it is to the adult. With this idea in view the society undertook and is successfully carrying on a great work in connection with the public schools of my country. About 35,000 school teachers obtain daily illustrated lessons in geography from the society conveying information too recent to be found in text-books. These lessons and pictures are used by the teachers in disseminating geographical knowledge to the children. Geography is to-day one of the popular subjects taught in the elementary schools, while a decade or more ago it was considered to be very dull and stupid.

Not only is the society issuing bulletins to school teachers throughout my country but at the request of the editors of about six hundred newspapers they are furnished daily bulletins on geographical subjects. I can not imagine any greater help in the stimulation of the interest of people in geography than this news service of the National Geographic Society.

While not one of the really old geographical societies of the world, the National Geographic Society may yet claim maturity or at least vigorous youth. It was founded in 1888 and has continued its existence from that time. It sends its greetings to the youngest geographical organization, the Pan-American Institute of Geography and History, which begins its existence on September 16, 1929.

The society has been a pioneer in the line of making geographical information valuable and interesting. There are few persons in the world who will read a dull statement no matter how accurate or valuable the data contained therein may be. There is so much literature in the world to-day that we instinctively are drawn towards that portion of it which is prepared in an attractive way, an article or a book that will hold our attention until we have completed it. Dr. Gilbert Grosvenor, president of the National Geographic Society, has reached almost the point of genius in the geographical field by making the magazine of the society carry the message of geography to even the humblest homes. His magazine is read by the highest officials of the national government and in the humblest fisherman's dwelling along the sea-coast, by the miner in his mountain camp and the farmer in his cottage. This is truly a great accomplishment and is a tribute to him.

The officials of the National Geographic Society are not strangers to the citizens of the other American nations. There have appeared many articles, beautifully illustrated, in its magazine depicting certain phases of the geography and history of the countries lying to the south of the United States. We may expect that the society will continue to publish these most interesting articles from the other countries of the western hemisphere which I can assure you are read with the greatest interest by the people of my country.

The society's work is substantially aided by its 3,700 members in Mexico and by 10,260 other members in Central and South American countries. This total of 13,960 members of this great geographical body from the Latin-American countries is a gratifying token of the interest and support you are tendering the advancement of geography.

I have brought with me a series of maps which have been published by the National Geographic Society which I have been asked to give to the director of the Pan-American Institute of Geography and History with the compliments of Dr. Grosvenor.

Upon my return to Washington I shall report to

the officials of the National Geographic Society with a great deal of pleasure the proceedings which have led to the formal organization of the Pan-American Institute of Geography and History and I shall assure them that in my judgment the institute is built on a broad foundation and that its future should be a bright one. Also that its work will undoubtedly result in a vast stimulation of geographical and historical research in the western hemisphere and that the results of such activities should redound to the benefit of the citizens of each of the countries which is adhering to the institute.

OBITUARY

ARTHUR McQUISTON MILLER MEMORIAL SERVICES

ARTHUR MCQUISTON MILLER, for thirty-five years professor of geology and archeology in the University of Kentucky, author of "The Geology of Kentucky" and other works, fellow of the Geological Society of America since 1897, died in Florida on October 28, 1929, of heart failure. The members of the society are invited to join in a meeting to be held in his memory on Memorial Day, Friday, May 30, at Lexington, on the lawn of his home, Maxwelton, adjoining the grove which he gave to the university. The chief speaker on the occasion will be Professor Collier Cobb, of the University of North Carolina.

Dr. Marion M. Miller, brother of Professor Miller, extends the hospitality of Maxwelton to all members of the society who can arrange to be present on the occasion. There are ample accommodations in this fine old mansion for a large group of scientific men and their families.

A committee of the leading citizens of Lexington, representative of the civic bodies of which Professor Miller was an active member, will have charge of the memorial and dedicatory exercises. Judge Samuel M. Wilson, Security Trust Building, is chairman, and to him tributes may be sent by members of the society who wish to pay their respects in this manner to Professor Miller's memory. Those who plan to attend should notify Dr. Marion M. Miller, Maxwelton, Lexington, Kentucky.

It is hoped by Dr. Miller that his guests will come prepared to spend the week-end in the Bluegrass country. A trip will be taken on Saturday to the Kentucky River Gorge, the great Dix River Dam, and to old Shakertown near the dam, where a banquet will be held in the Shakertown Inn. A memorial volume containing the addresses and tributes will be published during the summer and will be sent to members of the society.

MEMORIALS

THE Connecticut Agricultural Experiment Station has issued *Bulletin* 312 as a memorial to Dr. Thomas B. Osborne, who died in January, 1929. Dr. Osborne joined the station staff in 1886 at the invitation of Professor Samuel W. Johnson, director, and professor of agricultural chemistry in Yale University. Two years later he began his studies of the vegetable proteins that were to continue uninterrupted for forty years in the same laboratory. More than two hundred and fifty papers bear his name. The bulletin, entitled "Thomas B. Osborne: A Memorial," opens with an appreciation by Dr. E. H. Jenkins, director emeritus of the station. Dr. Osborne's work is described at length in an article, reprinted from SCIENCE, by Dr. H. B. Vickery, who succeeded Dr. Osborne as head of the station biochemistry laboratory, and Professor Lafayette B. Mendel, of Yale, who for many years collaborated with Dr. Osborne in nutrition experiments. This is followed by six of Dr. Osborne's papers, biographical notices and a complete bibliography of his work.

OFFICIAL notice has been received from the United States Geographic Board that the south arm of Port Snettisham, in southeastern Alaska, near latitude 57° 59′, longitude 133° 44′, has been named Gilbert Bay; and that the lake about 5 miles long lying to the eastward of that bay and about 10 miles inland from Stephens Passage has been named Gilbert Lake, in honor of the late Dr. Charles H. Gilbert, the ichthyologist, who was connected with the Bureau of Fisheries for many years. *The Fisheries Service Bulletin* writes: "It is fitting that tribute is thus paid to the memory of one who attained world-wide distinction in the field of ichthyology; and whose untiring investigations concerning the salmon fisheries, especially those of Alaska, contributed largely to the knowledge of these important fishes, both from a scientific point of view and from the standpoint of practical conservation."

RECENT DEATHS

DR. JOSEPH L. MARKLEY, professor emeritus of mathematics at the University of Michigan, died on April 20 in his seventy-first year.

DR. JOSEPH M. PATTON died on April 17 at the age of seventy-eight years. Dr. Patton had been a professor of clinical medicine at the College of Medicine of the University of Illinois and professor of internal medicine at the Chicago Polyclinic.

PROFESSOR C. KELLER, of the University of Zurich,

known for his work on the fauna of Somaliland and the Red Sea, has died at the age of eighty-two years.

It is reported that I. M. Michaelovsky, professor of physiology in the Mid-Asiatic University at Tashkent, has died from suicide or murder.

Nature reports the death of Sir William M'Cormick, chairman of the University Grants Committee and of the Advisory Council on Scientific and Industrial Research, on March 22, aged seventy years; and of Sir Edward Brabrook, a past president of the Royal Anthropological Institute, on March 20, aged ninety years.

SCIENTIFIC EVENTS

A CHEMISTRY HOUSE IN LONDON

According to the London *Times* the project to assemble all the chief chemical, metallurgical and mining societies in one new building at Westminster was outlined on March 27 by Professor J. F. Thorpe in his presidential address to the British Chemical Society at its annual meeting in Burlington House. He also put forward suggestions for securing ultimately a joint membership of the Chemical Society and the Society of Chemical Industry.

It is proposed that the central building for scientific and technical institutions shall be erected and equipped at a cost of £350,000, in Victoria Street, with the object of securing the close association between the scientific societies of the industries which has already been achieved in America and is in process of realization in France. The building will have a large common lecture hall and a library of about 70,000 volumes. It is intended also to provide club facilities.

In his address, as reported in the *Times*, Professor Thorpe spoke of the development in science and industry resulting from the application of lessons learned during the war. He said the spirit of cooperation or rationalization was causing many groups dealing with related subjects to join together in their own and in the national interests. It was certain that the next 20 years would witness a struggle for supremacy in scientific effort and in the industrial application of science throughout the world which would be even more intense than was the struggle between the contending nations during the war. It must be recognized that the separation into isolated units of the organization dealing with the scientific and technical development of the three basic industries was not in accordance with the existing state of scientific knowledge, and that the nation and empire could not utilize to the full the forces inherent in them unless some scheme could be devised by which close cooperation between these groups could be effected.

The need was urgent, because other nations, notably the French, were actively engaged in coordinating their chemical activities, and the Americans already had their Chemists' Club in New York. Unless, therefore, something was done, and that quickly, they would be handicapped in the struggle. It seemed that at last they were in a fair way to realize the Chemistry House of their needs at a cost which was about half what would be necessary if chemists were forced to act alone. They must look to the industries concerned to provide the greater proportion of what was required. When the general appeal was issued it would contain a list of definite promises amounting to £130,000, including some munificent personal donations, such as £10,000 from Mr. Robert Mond, £1,000 from Mr. Emile Mond and £1,000 from Sir Robert Hadfield. A petition had been sent to the chancellor of the exchequer asking for a Treasury contribution. The answer, however, was *"non possumus,"* although sympathy was expressed with the object in view.

Professor Thorpe then discussed proposals for the first steps towards a union of the Chemical Society and the Society of Chemical Industry. He said it would probably require twelve months' work on the part of the joint committee to elaborate all the necessary details and explore every avenue leading in the desired direction.

A SCIENTIFIC ADVISORY BOARD FOR THE WESTINGHOUSE RESEARCH LABORATORIES

The first meeting of the recently created Scientific Advisory Board of the Westinghouse Research Laboratories was held in East Pittsburgh, Pennsylvania, on April 16. The aim of the Westinghouse Electric and Manufacturing Company in establishing this board is to bring before their specialists recent scientific research.

The members of the board are: Dr. P. W. Bridgman, head of the department of physics at Harvard University; Dr. G. B. Waterhouse, head of the department of metallurgy at the Massachusetts Institute of Technology and chairman of the ferrous advisory committee of the U. S. Bureau of Standards; Dr. C. E. Mendenhall, head of the department of physics at the University of Wisconsin; Dr. Stephen Timoshenko, head of the school of advanced mechanics at the University of Michigan, who formerly worked for four years at the Westinghouse Laboratories, and Dr. Edward Mack, Jr., professor of physical chemistry in the Ohio State University.

It is planned that the board shall meet three times a year and that the individual members will follow closely all research work conducted by the company and act in an advisory capacity on matters concerned with pure science.

In a statement made by Mr. S. M. Kintner, manager of the laboratories, he says: "It is our purpose that the board members advise us along purely scientific lines. We expect them to stimulate our research specialists by their suggestions, to bring up-to-the-minute theories into our work and to act as a check on the scientific work upon which we are engaged."

Some members of the board will serve for one year and the others have been appointed for two-year terms. Thus, as changes are made in the personnel, there always will be members who have served for at least one year.

Plans now are being carried through for the enlargement of the present laboratories. An addition to the present building which will nearly triple the floor space is under construction at a cost of $500,000. The addition, which includes a large power house, will centralize the laboratories, some of which through lack of space have been forced to find quarters in the main plant.

THE TWENTY-FIFTH ANNIVERSARY OF THE ILLINOIS STATE GEOLOGICAL SURVEY

THE Illinois State Geological Survey through Dr. M. M. Leighton, chief, announces the celebration of its quarter-centennial anniversary. The celebration will be held in Urbana, on April 30 and May 1, in conjunction with the annual meeting of the Illinois Academy of Science on May 2 and 3, and will include two symposia, one on "Research Needs of Illinois' Coal Industry," and the other on "Studies Relating to the Order and Conditions of Accumulation of the Coal Measures." Many state and academic geologists have signified their intentions of being present, since the topics of discussion have wide-spread applications.

The proceedings will open with the dedication by Dr. Edson S. Bastin of the Quarter-Centennial Program to the memory of T. C. Chamberlin and R. D. Salisbury.

The dedication will be followed by a historical retrospect of geological investigations in Illinois and their relations to the state, when the speakers and subjects will be:

Investigations previous to the founding of the present State Geological Survey: PROFESSOR C. W. ROLFE.

The initiation of the State Geological Survey: DR. H. FOSTER BAIN.

The State Geological Survey during the period 1909–1923: MR. FRANK W. DEWOLF.

The State Geological Survey during the period 1923–1930: DR. M. M. LEIGHTON.

Speakers taking part in the symposium on the research needs of Illinois' coal industry will be Dr. M. S. Ketchum, Dr. J. A. Garcia, Dr. E. A. Holbrook, Dr. F. C. Honnold, Dr. S. W. Parr and Dr. Reinhardt Thiessen. Studies relating to the order and conditions of accumulation of the coal measures will be reported by Dr. J. Marvin Weller, Dr. H. R. Wanless, Dr. R. C. Moore, Dr. F. B. Plummer, Mr. Wilber Stout, Mr. David B. Reger, Dr. G. H. Ashley and Dr. David White.

Those who will take part in the discussions that will follow the symposia include Professors A. C. Willard, W. H. Severns and Dr. T. E. Savage, of the University of Illinois; Dr. Gilbert H. Cady, Illinois State Geological Survey; Dr. G. F. Kay, state geologist of Iowa and dean of the college of liberal arts and sciences, University of Iowa; Dr. H. A. Buehler, state geologist of Missouri; Dr. G. E. Condra, dean and director of the conservation and survey division, University of Nebraska; Dr. C. N. Gould, director of the Oklahoma Geological Survey, and others.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual meeting of the American Philosophical Society opened in Philadelphia on April 24. The Saturday night session commemorates the two hundred and third anniversary of the founding of the society by Benjamin Franklin, in April, 1727.

There will be a dinner on April 26 at the Bellevue-Stratford with Captain Sir Hubert Wilkins, explorer; Dr. James Rowland Angell, president of Yale University, and Dr. Edwin Grant Conklin, professor of zoology, Princeton, as speakers, and Dr. John H. Finley, of the New York *Times,* as toastmaster. Sir Hubert's subject will be "Seeking Useful Knowledge"; Dr. Angell's, "Promoting Useful Knowledge," and Dr. Conklin's, "The Service of Science to Mankind."

Papers and a report of progress will be presented in the "intellectual stock-taking" inaugurated last year by Dr. Francis X. Dercum, the president. All day-time sessions at which these papers will be read will be in the 141-year old hall of the society.

Papers on Thursday's program were read by Dr. Clinton J. Davisson, Dr. Herbert E. Ives, both of the Bell Telephone Laboratories; Professor Arthur E. Kennelly, Harvard University; Professor Clyde Eagleton, New York University; Professor Emory R. Johnson, University of Pennsylvania; Dr. Alfred V. Kidder, Carnegie Institution of Washington; Professor William B. Scott and Dr. Glenn L. Jepsen, Princeton University, and Professor Henry Fairfield Osborn, American Museum of Natural History.

The program for April 25 includes the annual ad-

dress of the president, matters of business and the election of officers and members, and papers by Dr. Detlev W. Bronk, Professor Rodney H. True, Dr. Harlan H. York, Professor Ephraim Avigdor Speiser and Professor John C. Rolfe, University of Pennsylvania; Dr. Albert F. Blakeslee and Dr. Howard J. Banker, Carnegie Station for Experimental Evolution; Dr. George W. Crile, Cleveland Clinic and Cleveland Clinic Hospital; Dr. Frederick S. Hammett, Research Institute of Lankenau Hospital, and Dr. Daniel T. MacDougal, Carnegie Institution of Washington.

The afternoon session on Friday is given over to a symposium on the outlook for higher education in the United States which was organized by Dr. Frank Aydelotte, president of Swarthmore College. The speakers are Dr. Abraham Flexner, former secretary of the General Education Board; Dr. F. J. E. Woodbridge, former dean of the Graduate School, Columbia University, and Dr. Aydelotte.

On Friday evening there will be a reception in the hall of the Historical Society of Pennsylvania and an illustrated lecture by Professor William F. Albright, of the Johns Hopkins University, entitled "A Millennium of Biblical History in the Light of Recent Excavations."

Speakers on Saturday morning will be Professor Fay Cooper-Cole, University of Chicago; Dr. Aleš Hrdlička, U. S. National Museum; Professor Roland B. Dixon, Harvard University; Dr. George Grant MacCurdy, Yale University; Professor David Reisman and Professor L. V. Heilbrunn, University of Pennsylvania; Professor E. Newton Harvey and Dr. Peter A. Snell, Princeton University; Professor J. H. Ashworth, University of Edinburgh, and Professor Samuel A. Mitchell, University of Virginia.

Saturday afternoon will be devoted to a symposium on astronomy and astrophysics organized by Dr. John A. Miller, director of Sproul Observatory, Swarthmore. In addition to Dr. Miller the speakers will be Professor Ernest W. Brown, Yale University; Dr. John S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B. C.; Professor John Q. Stewart, Princeton University, and Professor Harlow Shapley, director of Harvard College Observatory.

SCIENTIFIC NOTES AND NEWS

IN connection with the ceremonies in honor of the eightieth birthday of Dr. William H. Welch on April 8, an address with lantern illustrations was given at the London School of Hygiene and Tropical Medicine by the director, Sir Andrew Balfour, on Dr. Welch's life and work.

DR. CHARLES VALUE CHAPIN, who, beginning in 1884, was for a long series of years superintendent of health of Providence, Rhode Island, was presented with the Sedgwick Memorial Gold Medal for outstanding achievement in public health at the banquet of the New England Health Institute. The presentation was made by Surgeon-General Hugh S. Cumming, of the U. S. Public Health Service.

THE doctorate of science was conferred on Dr. C. G. Abbot, secretary of the Smithsonian Institution, by the Case School of Applied Science on the occasion of the installation of Dr. William Elgin Wickenden as president of the school. Dr. Abbot gave an address on "The Opportunities of Science."

DR. RODNEY H. TRUE, of the University of Pennsylvania, who is visiting Tucson, Arizona, and other points in the Southwest in connection with the work of the Committee of One Hundred of the American Association for the Advancement of Science, gave the John Wesley Powell Lecture at the University of Arizona on April 22.

PROFESSOR M. I. PUPIN, of Columbia University, has been elected president of the University Club of New York City.

DR. OSKAR LOEW, professor of chemical physiology in the University of Berlin, has been awarded the Liebig Medal of the Bavarian Academy of Sciences, in recognition of his services to agriculture.

AT the meeting of the Chemical Society, London, on March 27, the Longstaff Medal was presented to Dr. W. H. Mills, lecturer in organic chemistry at the University of Cambridge, and the Harrison Memorial Plaque and Prize to Dr. R. P. Linstead.

DR. HANS MOLISCH, professor of botany in the University of Vienna, celebrated the fiftieth anniversary of his doctorate on March 20.

DR. ALEXANDER WETMORE has been elected a foreign member of the British Ornithologists' Union. Dr. Wetmore sailed from New York on April 10 for Spain, where he will be engaged for a month in making collections of birds for the National Museum in the Cantabrian Mountains. Later he expects to visit museums in Paris, Brussels and London, and then to attend the International Ornithological Congress in Amsterdam.

THE sixtieth annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held at the University of Wisconsin on April 11 and 12, in

joint session with the Wisconsin Archeological Society and the Midwest Museums Conference. Officers of the academy were elected for a term of three years as follows: *President,* Charles E. Allen, University of Wisconsin; *Vice-presidents, Sciences,* Rufus M. Bagg, Lawrence College; *Arts,* O. L. Kowalke, University of Wisconsin; *Letters,* William E. Alderman, Beloit College; *Secretary-treasurer,* Lowell E. Noland, University of Wisconsin; *Curator,* Charles E. Brown, State Historical Society; *Librarian,* Walter M. Smith, University of Wisconsin.

DR. FREDERICK W. SCHLUTZ, recently head of the pediatrics division at the Medical School of the University of Minnesota, has been appointed to a similar post in the University of Chicago's South Side Clinics. Dr. Schlutz has arrived in Chicago to direct organization work for the Bobs Roberts Memorial Hospital for Children.

DR. CHAS. H. BEHRE, JR., assistant professor of geology at the University of Cincinnati, has resigned to accept an associate professorship of economic geology at Northwestern University.

DR. HOWARD H. MARTIN, assistant professor of geography at the University of Cincinnati, has been appointed associate professor of geography in the College of Science, University of Washington, Seattle, the appointment to take effect on October 1.

DR. JULIAN D. CORRINGTON, assistant professor of zoology at Syracuse University, has been appointed associate professor of biology at Drew University, Madison, N. J.

AT a meeting of the Michigan State Board of Agriculture, April 4, the following appointments and promotions were made at Michigan State College: Dr. Marie Dye, acting dean of home economics, dean of home economics; Dr. E. A. Bessey, acting Dean of applied science, dean of the graduate school; Dr. R. C. Huston, professor of chemistry, acting dean of applied science; Dr. D. T. Ewing, associate professor of chemistry, professor of physical chemistry, and Dr. W. A. Kelley, instructor in zoology, assistant professor of zoology. Dr. Bessey retains the headship of the department of botany and Dr. Huston remains in charge of the work in organic chemistry.

DR. PHILIPP BROEMSER, of Bâle, has been called to a professorship of physiology in the University of Heidelberg.

MR. WARD SHEPARD, assistant chief of public relations in the Forest Service, resigned on March 31 to become associated with Dr. Gifford Pinchot in forest work.

DR. HERBERT C. WARD, chief of the bureau of bacteriology of the Maryland State Department of Health, has resigned to accept a position with a commercial house in Chicago.

DR. P. L. GAINEY, of the department of bacteriology of the Kansas State Agricultural College, will represent the college at the second International Congress of Soil Science to be held at Moscow and Leningrad in July.

THE Committee on Scientific Research of the American Medical Association has made an appropriation of $500 to the department of bacteriology of the School of Medicine and Dentistry of the University of Rochester at Rochester, New York, for research on chemotherapy in tuberculosis. The grant is to aid the work of Dr. Georges Knaysi, of the New York State College of Agriculture, who has been granted leave of absence by Cornell University and will conduct his experiments at the University of Rochester.

PROFESSOR A. S. HITCHCOCK gave an illustrated address before the Botanical Society of Washington on April 1 on "A Botanical Trip to South and East Africa."

DR. J. ARTHUR THOMSON, Regius professor of natural history at the University of Aberdeen, delivered a lecture on April 5 before the Royal Canadian Institute on "The Drama of Animal Life."

DR. JONATHAN CAMPBELL MEAKINS, of McGill University, will lecture on "Hypertension" at the Medical School, University of Buffalo, under the Harrington Foundation, on May 1 and 2.

ON April 22, Captain Sir Hubert Wilkins addressed the American Geographical Society on "Further Antarctic Explorations." He described the results of his 1929–1930 expedition, including his aerial flights over a part of the Antarctic Archipelago, Charcot Island and the ice pack farther west, and outlined his plans for the setting up of meteorological stations in the Antarctic. Through the use of moving pictures he showed the contrast between the old and the new methods in polar exploration.

FOR his Friday evening discourse delivered at the Royal Institution on March 28, Sir Ernest Rutherford took as his subject "The Transmutation of Matter."

A SYMPOSIUM in Theoretical Physics will be given during the summer school at the University of Michigan, from June 30 to August 22. The program is as follows: Professor P. Ehrenfest, University of Leyden, "Problems of Modern and Classical Physics"; Professor E. Fermi, University of Rome, "Quantum Electrodynamics"; Dr. Philip M. Morse, Princeton University, "Quantum Mechanics"; Professor S. A.

Goudsmit, University of Michigan, "Theory of Atomic Spectra," and Professor G. E. Uhlenbeck, University of Michigan, "Application of the Theory of Probability in Physics." Professor Ehrenfest will conduct seminars twice a week which will give opportunity for informal presentations and discussions of the most recent problems of modern physics.

PROFESSOR H. L. BOLLEY, dean of biology in the North Dakota Agricultural College, botanist and plant pathologist at the Experiment Station, has been granted leave of absence for the year beginning on July 1. He will spend some months in temperate regions of South America, particularly in Argentina, making observations and photographic records on botanical and agronomic lines similar to the studies he has conducted in North Dakota. He will make a study of the ecological relations of parasites and hosts in relation to sanitary cropping, giving special attention to smuts, rusts, root and seedling blights.

DURING the spring holidays, a party from the Brown University department of geology made a week's trip through parts of Connecticut, New Jersey, Pennsylvania, New York and Massachusetts. Observations were directed by Professor Bradford Willard, and were confined chiefly to the character, structure and fossil content of the Paleozoic formations. Professor B. L. Miller, of Lehigh University, conducted the party through part of the Lehigh Valley cement belt. Of particular interest were the new Alexander Caverns near Reedsville, Pennsylvania. A considerable number of fossils was secured for the department collections.

SYRACUSE UNIVERSITY will send an expedition to the Andes Mountains next January for four months of exploration. Using the modern city of San Cristobal as the base of operations, the expedition will explore the unknown country for 200 miles about the city. Included in the party will be Dr. Struthers, who is director of the Syracuse University Museum of Natural Science; Dr. Ernest Reed, botanist; Sidman Poole, professor of geography at Syracuse University; Dr. Earl T. Apfel, professor of geology and oil-geologist; Dr. Edward Reid, of Rome, New York, doctor and surgeon, and Ellis Thompson, assistant purchasing agent, business manager. Professor Struthers has lived two years in tropical America in preparation for the expedition and has led four expeditions into various parts of the Caribbean. Special equipment is being taken for exploring some of the rivers flowing into the Orinoco. It is planned to divide the party into at least two groups at San Cristobal in order to cover more ground and let men work in regions especially favorable to their particular objectives. At least once a month the groups will return to San Cristobal for reorganization and coordination of data. Contact with headquarters will be kept at all times by the use of native runners.

THE State Department announced on April 16 that an expedition for the exploration of the northeast coast of Greenland will be carried out this summer at the request of the Museum of the American Indian, Heye Foundation. The expedition will be in charge of Captain Robert A. Bartlett, who will be accompanied by Junius Bird, on the schooner *Morrissey* of eighty tons. They will collect archeological and ethnological specimens. The *Morrissey* will go to Scoresby Sound and northward, remaining in Greenland from 6 to 8 weeks.

APPLICATIONS for associate and assistant metallurgist, at salaries of $3,200 and $2,600 a year, respectively, must be on file with the Civil Service Commission at Washington, D. C., not later than May 28. The examinations are to fill vacancies in the departmental service, Washington, D. C., and in the federal classified service throughout the United States. The duties are to conduct mining and metallurgical investigations and dissemination of information with a view to improving conditions in the mining, quarrying, metallurgical, and other mineral industries, especially with a view to preventing unnecessary waste of resources and otherwise contributing to the advancement of these industries. The optional subjects are (1) ferrous metallurgy, (2) nonferrous metallurgy, (3) physical metallurgy, and (4) ore dressing. Applications must be on file with the commission not later than May 14, for the positions of associate entomologist ($3,200 to $3,700 a year) and assistant entomologist ($2,600 to $3,100 a year), to fill vacancies in the Bureau of Entomology, Department of Agriculture, and in positions requiring similar qualifications. The optional subjects are (1) apiculture, (2) biological control of insects, (3) cereal and forage insects, (4) deciduous fruit insects, (5) forest insects, (6) insects affecting man and domestic animals, (7) tropical and subtropical insects, (8) truck crop insects.

THE London *Times* reports that after several months' labor the skull of the Peking Man has been freed from its stony matrix and was on view at the annual meeting of the Geological Society of China on March 29. Much delicate work with dentist drills and special tools was required to cut away the mass of hard travertine in which the skull was embedded. The process revealed the absence of the facial part of the skull, but the heavily developed supraorbital ridges remain, and the cranium is complete except at the base. Dr. Black stated that the study of the cleaned

skull had not yet begun, and there was nothing fresh to say on the subject except that the skull showed a peculiar condition of the ear region in shape and a very unusual expansion of the tympanic bone, from which, after examination, important conclusions might be reached. In the course of the meeting it was stated that geologists had made the interesting discovery that the volcanoes in the Tatungfu coal area in North Shansi had ejected quantities of lava, which covered the sands and clays formed approximately during the same period as the Choukoutien deposits in which the remains of the *Sinanthropus Pekinensis* were found.

Anopheles gambiae African was found breeding in Natal, Rio Grande do Norte, Brazil, on March 23, by Mr. Raymond C. Shannon, who is engaged in entomological research in connection with the yellow fever studies of the Rockefeller Foundation in Northern Brazil. The cable reporting this discovery says that this is the first Myzomyia found in the New World. Mr. Shannon is of the opinion that the species is probably of recent importation to Brazil, although the large numbers of larvae and pupae found indicate it to be well established in the vicinity of Natal. Dr. L. O. Howard, entomologist for the U. S. Department of Agriculture, comments as follows: "The cablegram about Shannon's finding is extremely interesting. *Anopheles gambiae* is found in many places in Africa. It is wide-spread throughout the coastal belt of South Africa, is a recognized carrier of malaria throughout the Ethiopian region and is known in Zululand, Zanzibar, all through Portuguese East Africa, southern Rhodesia, in Nairobi, the Gold Coast and Mauritius. It is a common frequenter of houses and a ready carrier of malaria. It is, in fact, the species that appears on the crest of the Royal Society of Tropical Medicine. The name *Myzomyia* occurring in the cablegram is that of a genus of Anopheline mosquitoes founded by Blanchard in 1902. It is now considered to be subgeneric in rank. The species heretofore have been known only from Africa and India. Natal, Brazil, is a seaport and therefore a likely place to look for introductions of this kind. Since Mr. Shannon has found it breeding there, it is likely to have become a permanent resident; and thus we know of another bad malaria carrier in the Americas."

ON April 2, 1930, the seminars of the departments of psychology and zoology of the University of California met together to hear and discuss a paper by Professor Emeritus Wm. E. Ritter entitled "Is Man a Rational Animal?" By way of a general introduction Professor Ritter said: "According to the system of thought descended to us from Plato through Descartes, Kant and others, psychology is the science of the mind and biology is the science of the body. This makes life a house divided against itself. What psychology has suffered from the conception of bodiless minds is not for me to say. What biology has suffered from the conception of mindless bodies I could discourse on long and, I think, convincingly. It would be a fine thing, it seems to me, if this joint meeting of psychologists and zoologists might be the first of many similar meetings to the end of replacing the divided house theory of life by a united house theory. This might lead finally, for our own university at least, to a philosophy of life symbolized by the fact that so many of the sciences devoted to living nature are now housed together in this magnificent new building with its conspicuous label, 'The Life Sciences.'"

Industrial and Engineering Chemistry reports that the United States Court of Appeals for the Third District has held that the ownership of patents seized from enemy owners by the Alien Property Custodian during the war and the right to recover the royalties paid to the Treasury of the United States by lessees for their use rests with the purchaser, the Chemical Foundation, which acquired the patents from the Alien Property Custodian under executive order. The patents were owned before the war by three German organizations and, under the Trading with the Enemy Act, were seized by the Alien Property Custodian, and licenses to use them were granted to E. I. du Pont de Nemours & Co., Inc. The royalties which the du Pont Company was required to pay were subsequently turned over by the Alien Property Custodian to the Treasury of the United States before the patents were sold to the Chemical Foundation. The latter filed a bill in equity to recover from the Treasury of the United States so much of the license money as would cover the royalties. Almost immediately the German owners filed similar suits and the Alien Property Custodian filed a motion to be substituted for the German owners. The Circuit Court held that upon seizure of the property the enemy owners lost their rights thereto, as well as their rights to royalties, and therefore at the time of their filing the bill they were not owners of either. The ownership of the Alien Property Custodian was also denied by the court on the ground that in his sale to the Chemical Foundation he had disposed of every right acquired under the seizure. The court finally ruled that both ownership and right to royalties were vested in the Chemical Foundation. This decision upholds that of Judge Hugh M. Morris, of the Federal District Court of Delaware.

THE program of papers to be read by international authorities at the World Poultry Congress in July is now being prepared. Papers in the British section will come under five heads—(*a*) breeding and incubation; (*b*) nutrition and rearing; (*c*) diseases and their control; (*d*) economics and marketing; (*e*) education and general—while in addition there will be several papers on rabbits. Professor R. C. Punnett will contribute an important paper dealing with experiments on the inheritance of fecundity in fowls, and Mr. Tom Barron, the pioneer breeder of pedigree laying stock, will explain the Lancashire Utility Poultry Society's breeding scheme, which for the first time introduces the principle of the stud book in poultry breeding. Dr. G. Scott Robertson, of the Ministry of Agriculture of Northern Ireland, will speak on nutrition of the chick and the effect on growth; Mr. Tom Newman will contribute a paper on food in relation to the hen; Professor Parkhurst, of the National Institute of Poultry Husbandry, will discuss the use of cod-liver oil in the ration of the laying hen, and Dr. J. B. Orr, principal of the Rowett Institute, will tell of the mineral and protein requirements of poultry. Dr. Ethel Cruikshank and Dr. F. C. Kelly will speak of the uses of iodine in the poultry yard, and papers on diseases stand in the names of Major Dalling, Captain Doyle and Mr. E. Lionel Taylor. Mr. A. W. Street, Professor A. W. Ashby and Captain Hunt are among the readers of papers on economics and marketing, and on the educational side the contributors will include Dr. Charles Crowther, of the Harper Adams Agricultural College, and Mr. P. A. Francis, director of the congress. Since the resumption of diplomatic relations the Soviet government has accepted an invitation to be represented at the congress, and arrangements are being made whereby a national exhibit will be staged showing phases of poultry practice in Russia.

THE proposal last July by the director of the British Museum for a new edition of the General Catalogue of Printed Books has resulted, according to the London *Times*, in a large number of advance applications for the work. Two hundred subscribers are already guaranteed from the United States, together with 130 from British librarians and librarians abroad, many of whom have received prospectuses through the Foreign Office. A second and more definite prospectus is accordingly being issued immediately by Sir Frederic Kenyon, the director of the museum, in which the full terms of subscription are announced. The volumes, consisting each of 500 pages, are to be issued to original subscribers at £3 each, while the published price will be £4 a volume. The trustees of the museum propose alternately to accept a sum of £400 in advance for the complete catalogue as issued. It will consist of about 165 volumes, but not more than 12 of these will be issued in any year. They will be delivered in batches at intervals of six months, while a monthly record of accessions is to be issued for a subscription of £3 a year. It is to be observed that the form sent out to would-be subscribers imposes certain safeguards upon the conditions of sale, and some discretion is allowed the trustees to refuse to accept the names of certain subscribers, to increase the price of volumes still to be issued should the cost of production increase, and to vary the terms of their performance owing to war, strikes, fire and other forms of *force majeure*. Should the price of any volumes be in fact increased subscribers will have the right to discontinue. Two announcements of changes in the plan of the catalogue also appear. The practice of regarding I and J as the same letter (and similarly of U and V) will be abandoned, and the heading "Academies," under which learned societies have hitherto been classified, will vanish in favor of a distribution of those societies beneath local headings, according to the town which is their headquarters. Work on the catalogue has already been set in progress under the retiring keeper of books, Mr. R. Farquharson Sharp. His successor, Mr. Marsden, has been compelled to refuse a number of applications for work on the catalogue from outside the museum. It should be made known that no unofficial help is at present required. The work is expected to take from 15 to 20 years.

DISCUSSION

THE FUTURE OF TAXONOMY

IN discussing the inadequacy of support given the *Zoological Record*[1] Professor T. D. A. Cockerell ascribes the situation to (1) the competition of *Biological Abstracts* and (2) the lack of interest in taxonomy. With regard to the first I will only call attention to the fact that the publishers of the *Zoological Record* were complaining of inadequate support long before *Biological Abstracts* came into being,[2] and that they even threatened to discontinue the publication of this valuable bibliographic work if

[1] SCIENCE, 71: 240–241, February 28, 1920.

[2] SCIENCE, 54: 663, 1921.

more adequate financial support was not forthcoming.[3]

It is probably true, in the entomological field at least, that there is a relatively small percentage of the total number of workers engaged in taxonomic research, but I do not believe this to be due to a lack of interest. On the contrary, the evidence that is available seems to indicate that there has been a steadily increasing interest in taxonomy during the last seventy years, not only in the United States but throughout the world. The number of papers published in any particular field is, I believe, some indication of the interest taken in that field. In a recent paper, as yet unpublished, the writer has pointed out that there has been a steady increase in the number of papers published in the field of entomological taxonomy from 1864 up to the present time. This is true both for the United States and for the world as a whole. The only noticeable slump in the output of such papers was during the world war years.

Professor Cockerell goes further, however, and attributes this alleged lack of interest in taxonomy to our graduate schools. The reasons that are given to justify this indictment of the graduate school system are (1) lack of equipment, that is, library facilities and museum material, and (2) the inherent inadaptability of taxonomy as a thesis subject for graduate training. In these days when every reputable institution has at its command the convenience of interlibrary loans, lack of library facilities is not the reason that students are not preparing themselves as taxonomists. With respect to museum material, I believe it is true that those institutions which have most developed graduate training in entomology have the largest and best insect collections outside of the established museums. The material in those collections and the insect material in many of the museums are available to first-class graduate students for purposes of research, so that lack of material is not the reason taxonomy is not more generally chosen as a thesis subject. The charge that the subject of taxonomy is not suitable for a thesis problem because of the inherent difficulties involved is one that can be made regarding any field of science. Not all the problems in taxonomy are adapted to the needs of graduate school training; neither are all the problems in experimental zoology, genetics, ecology or any other branch of science so adapted, but no one contends that any of these fields as a subject is unsuitable for graduate training. Taxonomy is no different from these other fields in this respect, and it will be found that there are many problems of a taxonomic nature that can be easily adapted for the needs of graduate school training.

[3] SCIENCE, 57: 577, 720, 1923.

While there may be no lack of interest in taxonomy there seems to me to be no question that entomological taxonomy in competition with other fields of entomology is not attracting the number of capable young men that are needed in this field. The cause of this situation is very obvious. Entomological taxonomy is not receiving financial support in the same proportion as other lines of entomological work. Not only is the number of positions available in this field ridiculously low, but the salaries allotted to those positions are much lower than those for similar ones in other fields of entomology. Taxonomy, then, is competing with these other fields in attracting capable men, with a handicap of few positions and low salaries. Naturally there is a "lack of interest" in taxonomy. The result of this competition is that at present there are hundreds of full-time workers in the research field of economic entomology compared with a mere handful in entomological taxonomy. This proportion is reflected in the staff of the Bureau of Entomology which on July 1, 1929, had 257 workers of the rank of junior entomologist and above, engaged in economic work, and sixteen workers of similar rank in taxonomy. The latter are flooded with specimens of insects sent in from all parts of the country for identification so that the amount of time that can be spent in actual research is exceedingly small. The young man of to-day, then, who considers preparing himself as a taxonomist in entomology faces the prospect of few available positions, a distinctly lower salary than that paid to other entomologists and, if fortunate enough to obtain a position, very little time for actual research. Professor Cockerell asks why it is "that the Bureau of Entomology with its really enormous appropriation and abundance of technicians of all sorts has never given us a monograph on the Coccidae." The answer is that there is only one man in the Bureau of Entomology with the training and experience necessary for producing such a monograph, and he is so loaded down with routine identification work and administrative duties that he has practically no time for research. The same statement is applicable to practically all other taxonomic workers in entomology throughout the country. If taxonomy is to progress and perform its function adequately with relation to other entomological activities it must receive greatly increased financial recognition. Salaries should be increased and the number of workers considerably augmented to take care of the increasing demands made by workers in related fields. When these conditions come about, and they must come about if entomologists in general are to be adequately served by the taxonomists, there will be no "lack of interest" in taxonomy. Capable men will be attracted to the field and graduate schools will perform their func-

tion of providing them with the scientific training necessary for research in taxonomy.

UNIVERSITY OF MINNESOTA CLARENCE E. MICKEL
MARCH 6, 1930

PRESSURE POTENTIAL IN A FLUID

THE above title is intended to designate a concept in connection with a fluid pressure field similar to the concept of electric and gravitational potential. It is presented with the expectation of adverse criticism. However, to the author's mind, there are several points in favor of the concept.

First. According to the defining equation, $p = F/A$, pressure is a vector quantity, which is inconsistent with the equation, $pV =$ work, in which p is apparently a scalar quantity. Now if we define absolute pressure potential at a point in the fluid as the work per unit volume required to produce a displacement, the inconsistency is removed, provided p, in the second equation, designates this pressure potential. The difference in potential between two points is defined as it is for the electric field. Such a potential might be thought of as a condition of stress existing in the fluid, whereby a pressure (vector quantity) is caused to act on a surface in contact with the fluid if there is a difference in pressure potential between the two sides of this surface. The symbol P is suggested.

Second. The water analogue used in teaching current electricity is made more complete and can be used in teaching static electricity if this scalar quantity, pressure potential, is used instead of the vector quantity, p. The analogue can even be carried through the equations.

Third. The treatment of sound is materially aided by such a concept. The pressure potential gradient in a sound field gives a pressure field intensity and an acceleration similar to the gravitational field intensity and acceleration in connection with the gravitational potential gradient. The analogue might also be carried over to electromagnetic waves.

W. H. PIELEMEIER
PENNSYLVANIA STATE COLLEGE

CONGLOMERITE, A NEW ROCK TERM

GEOLOGISTS make careful distinction among sand, sandstone and quartzite, basing the separation upon the relative degree of cementation of the grains of each type of deposit. Thus, sand is simply a mass of uncemented grains, usually predominantly of the mineral quartz. Sandstone goes a step farther in that the grains are cemented together in varying degrees of firmness. In quartzite the cementing is still firmer, amounting usually to a welding together of grains with matrix. The distinction is usually not difficult to make. Sandstones themselves vary in degree of cementation from such friable examples as crumble between the fingers to those which break only with difficulty under the blows of the hammer. However, in every true sandstone the cement yields more easily than the grains so that fracture takes place in the matrix *around* rather than *through* the individual particles of sand. When a quartzite is broken, however, it is noted that the fracture passes, usually with equal ease, through both grains and matrix. So much for the nomenclature of relatively fine-grained types; what of the coarser sediments?

When we attempt to distinguish pebbles as gravel from conglomerate, the separation is simple, exactly like that by which sand and sandstone are differentiated. That is, the individual pebbles in a gravel bank are not cemented one to another, but the fragments of rock, "phenoclasts," in a conglomerate are cemented together. However, there appears to be no term in general use for distinguishing among conglomerates those in which fracture is through the matrix, from those types in which fracture is through matrix and pebble with equal ease. These conditions are of course analogous to those encountered in sandstone and quartzite respectively. Examples of indurated conglomerates in which there has been a welding together of matrix and pebbles are not rare. They are particularly well illustrated in the partially metamorphosed or "stretched" Carboniferous conglomerates of Rhode Island, especially those east of the City of Newport and at Natick. In these it is rarer to have the pebbles break out under the hammer than for the rock to fracture cleanly through irrespective of pebble and cementing material. Not only is this true, but joints, faults and other fractures pass in surprisingly smooth surfaces impartially through pebble and matrix.

It is suggested, therefore, that the term conglomerate be restricted to those pebbly rocks which break through the matrix and around the pebbles after the manner of sandstones. For the type in which fracture is through the pebbles and matrix, analogous to the conditions observed in quartzite, the term *conglomerite* is proposed. This term is suggested because its similar ending to quartzite should make its usage the more ready. Adopting such a term, we would then recognize the three grades of coarse sediments, gravel, conglomerate and conglomerite corresponding to sand, sandstone and quartzite in the next finer series.

BRADFORD WILLARD
BROWN UNIVERSITY

BANANA STOWAWAYS AGAIN

THE discovery of individuals of the genus Marmosa on stems of imported bananas has resulted in several

being recorded from the United States.[1] This note presents another record and comments on the conditions under which the mammals may exist before being discovered as well as upon their food habits and the method of carrying the young.

In March, 1928, the writer was asked to identify a "rat" that had been found on a bunch of bananas. The "rat" proved to be a female opossum, genus Marmosa, with two young firmly attached to her mammae. The species was not *M. isthmica,* with which the writer is familiar, but was, possibly, *M. zeledoni.*

It is difficult to understand how an animal as delicate as these opossums appear to be could withstand the adverse conditions met in such a trip. Granting that the journey from the plantation to the hold of the ship is not very severe, the survival of the young in a hold the temperature of which is held at 57° F. is remarkable, as this temperature is much lower than that encountered in their native habitat. Moreover, the bananas are green and so are not fit for food.

The specimens that came into my hands not only had survived the voyage from Central America to New York City, but the trip to Albany, seven days in cold storage there and finally a trip by truck to Schenectady. The animal was first seen in Albany, but eluded capture. It was found later on a stem of bananas hanging in a ripening room in Schenectady where the fruit had been taken. On capture the mother and young were placed in an empty candy jar where the writer first examined them. After the escape of the female the two young were preserved for dissection.

The point brought out by Kraatz concerning the food habits is of interest, for one species of the genus, *M. isthmica,* appears to do well on a variety of tropical fruits if they are ripe. One specimen kept by the writer starved to death without attempting to eat coconut or fresh sweet corn and without molesting the two young she had been mothering, and which survived her. Others have been kept for several weeks on banana and papaya. Donato, the Indian overseer, assured me that this species dies if not fed ripe banana, and my experience verifies his statement. With this in view, how do the stowaways survive the trip with apparently nothing to eat but green bananas? Is it possible that they find food of some other sort, insects, for instance? The specimen from Schenectady survived two weeks or more; caged specimens in Panama died in a day or two if not fed.

Young observed in Panama still clung to the female after their teeth had developed and they were not nursing. At this stage of development they clung to the female with their mouths, usually seizing the fur on the sides or on the ventral surface.

INSTITUTE FOR RESEARCH IN TROPICAL AMERICA AND MISSOURI VALLEY COLLEGE
ROBERT K. ENDERS

[1] SCIENCE, February 24, 1928; April 20, 1928; March 14, 1930.

WHEN BELIEVING IS SEEING—AN OPTICAL ILLUSION

DURING a stormy Atlantic crossing not long ago the writer observed a most striking demonstration of the way in which the eye may be aided, or, as in this instance, deceived, by the sense of equilibrium. The ship had been tossing violently for several days and most of the passengers were confined to their staterooms. A group of us, however, were seated one evening near the head of the main stairway. The opposite side of the lounge, seen across the intervening open space of the stairway, quite obviously rose and fell with the motion of the boat, as we, in the group of observers, alternatingly rose and fell.

After watching the apparent motion in an absent-minded way for some time it occurred to the writer to question it and to endeavor to ascertain how this visual impression of motion was registered. How were our eyes able to gauge the movement? By what was it measured? Motion can be "seen" in any one of several ways, but in each case an adjustment of the eye muscles is involved, and this adjustment defines the character and the direction of the movement. We braced our bodies and chairs against the movement of the boat. Our heads were held rigid and our eyes fixed upon a certain point to avoid any muscular adjustment to actual movement on the opposite wall. In spite of every precaution the wall of the saloon opposite to us still obviously rose and fell, see-saw fashion, as our bodies traveled in the opposite direction.

A careful examination of all visible portions of the room and stairway revealed no moving or swaying objects. The night was inky-black outside, with no sign of a light at sea to mark the horizon. Yet the motion continued to be so "visible" that it was hard to believe that no change of focus was necessary in following it. The conclusion to which we were finally forced was that when our semicircular canals registered motion for ourselves, in a certain direction, our minds, receiving this message, passed on to our eyes a demand for what was logically to be expected of them. They being faithful cooperators obediently "saw" what they were supposed to see at a time when our bodies were being tossed up and down in space. In this case, the thing to be expected was the motion which has been described, of the floor, walls and ceiling of the heaving ship's saloon; so this was what they "saw."

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REPORTS

THE WESTERN COOPERATIVE OIL SPRAY PROJECT (1929)

INTRODUCTION

OIL sprays have been used as insecticides for a number of years. However, the selection and preparation of early oil sprays were not standardized. In consequence of variable results obtained in commercial and experimental use, oil spray applications were attended with considerable risk and with marked uncertainty of effect. A meeting of entomologists and chemists was held at Tacoma, Washington, in June, 1926, to consider the variables encountered in connection with the use of oil sprays and to formulate plans for a concerted and coordinated attack on the problem. At this time an organization known as the Western Cooperative Oil Spray Project was formed.

At first, only entomologists and chemists participated in the project, bringing about a close cooperation between the agricultural experiment stations of California, Idaho, Montana, Oregon, Washington and British Columbia, and the U. S. Department of Agriculture. However, since a thorough study of oil sprays could not be made unless the effects of oils in plant tissue were also considered, the scope of the project was later enlarged to include horticulturists and plant physiologists.

Annual meetings are held for discussion of results and to formulate definite plans for further experimental work. This work has now been in progress for four years, and it is the purpose of this article to summarize the more important results obtained. A preliminary report was published in SCIENCE.[1]

This year (1929), representatives of oil refiners, spray manufacturers and other commercial concerns interested were called in conference immediately following the annual meeting. The results of experimental work with oils were discussed, and the commercial interests unanimously agreed to cooperate with the experiment stations by making their products and recommendations conform to the findings of investigational work. It is believed that a marked benefit will result from this cooperation.

DORMANT OIL SPRAYS

Oils for dormant use have repeatedly demonstrated their value as a spray treatment for San José scale, orchard leaf-roller, red spider, tree-hoppers, etc. It has been found that a lubricating type of oil with a viscosity range of 100 to 220 seconds Saybolt is satisfactory for dormant use. High refinement of oils for dormant use is not necessary since those with a sulfonation test of from 50 to 85 have proved safe when properly emulsified and applied.

The emulsifier used in oils during this period is an important factor from the standpoint of plant injury. While the emulsifier in itself has no injurious effects, the size of the dispersed oil droplets and the stability of the emulsion produced by the emulsifier influence the amount of oil that is deposited and retained on the plant. Quick-breaking emulsions have been found to cause severe injury to trees if applied during a critical period of bud development. This period may be said to exist from the time the buds first show green until the cluster buds separate. While quick-breaking emulsions have given better control of insects in laboratory tests, these differences have not been evident generally in field tests. Therefore, it has been suggested to manufacturers that more stable emulsions be placed on the market.

The time of application of oil was found to be a most important factor. All the oil sprays tested were used with apparent safety if applied before the bud scales separate, even when applied as early as January 15 and when sub-zero weather was encountered following application. However, considerable injury followed the application of quick-breaking emulsions and slight injury from the use of stable emulsions if the application was made during the critical period mentioned above. This is particularly true of trees of the winesap variety or of trees of low vitality.

SUMMER OIL SPRAY

Highly refined oils for summer sprays have proved to be very effective in the control of such insects as red spiders, newly hatched scale, etc. Oil sprays in combination with lead arsenate have also given improved control of the codling-moth. In this combination the oil has a definite ovicidal value while at the same time it increases the larvicidal value of the lead arsenate. Oils in combination with nicotine sulphate have also proved effective in controlling codling-moth, red spider, aphis, etc.

Oils have been studied with respect to volatility (either from the standpoint of evaporation or from the distillation ranges), viscosity and degree of refining or unsulfonatable residue. One property is often conditioned or determined by another so that they can not be varied independently and it is difficult to arrive at a valuation of their effects separately.

In the oils used, the viscosity range varied from 50 to 120 seconds Saybolt. Toxicity for insects within this range was found to increase with viscosity. At a viscosity of 50 seconds oils were relatively ineffective against red spider and codling-moth unless the concentration of the spray was increased consid-

[1] SCIENCE, 67 (1744): 560–561, June 1, 1928.

erably. On the other hand, injury to plants was found to increase with an increase in viscosity of oils above 70 seconds. It becomes necessary, therefore, to select an oil with an intermediate viscosity. It has been found that oils having a viscosity range of 65 to 75 seconds are generally satisfactory when used in a limited number of applications, although certain apple varieties (such as the yellow Newtown) are susceptible to injury from oils with viscosity above 55 seconds.

The degree of refinement of the oils was found to be another important factor in avoiding injury to plants, although even the most highly refined types sometimes produced injury. Whether this injury is due to oxidation of the oil or to the inability of the plants to tolerate absorbed oil of medium to heavy viscosity within its tissues has not been definitely determined. It has, however, been determined that the carbohydrate metabolism of leaves and vegetative spurs may be adversely affected by oil sprays.

With oils refined by the sulphuric acid method, it has been found that those having an unsulfonatable residue of 85 per cent. or more are preferable for use on plants during the growing period. At the present time it appears that oils produced under the liquid sulphur dioxide process of refinement have a greater stability against later oxidation and may therefore have a greater range of safety when applied to living plants. However, further tests are necessary definitely to determine this point.

The type of dispersion of oils in emulsions used during the growing season has not been found to be important where high pressure is used in spraying. This is probably due to the modification in the emulsions produced by the high pressure through the spray guns, reducing the oil droplet size in the less stable emulsions. This probably accounts for the fact that field tests during the last three years have shown but little difference in the insecticidal value of quick-breaking and stable emulsions. Such differences, however, were found in laboratory tests when the oil emulsions were sprayed with atomizers or equipment using low pressure.

Plant injury from summer oil sprays has followed repeated applications of oils having a viscosity range of 70 to 120 seconds. This has resulted in a russeting of the fruit in many cases and in a general reduction in the size of the fruit. It was found that not over two or three applications of such oil sprays could be used if serious damage of this nature is to be avoided.

It has also been found that serious foliage and fruit injury and dropping occurs when oil sprays are applied on trees carrying unoxidated sulphur deposits. The period that must elapse after use of sulphur sprays or dusts before oil sprays can be safely used varies with weather conditions. In hot weather, it is relatively short, but in cool weather it may be as long as sixty days. The Stayman winesap apple is especially subject to this type of injury, but all varieties are affected when it is necessary to use sulphur for fungicidal purposes.

The use of oil sprays late in the summer while heavy deposits of lead arsenate remain on the fruit or the use of medium or heavy oils in combination with lead arsenate late in the summer was found to complicate seriously the problem of spray residue removal. In some cases it has been impossible to clean such fruit satisfactorily. However, where not more than two applications of oil spray are made in combination with lead arsenate for the first brood of codling-moth or where the nicotine-oil combination without lead arsenate is used for the second brood of codling-moth, the arsenical residue problem has not been seriously complicated.

R. H. ROBINSON,
D. F. FISHER,
ANTHONY SPULER, *Chairman*
Publication Committee

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SEDIMENTATION TUBE FOR MECHANICAL ANALYSES[1]

IN making mechanical analyses of sediments, the dispersal of the constituents is commonly facilitated by shaking with water in bottles for several hours, and the sands are usually separated from the silts and clays by a series of decantations. In these processes, especially if the sample be sandy, it is a time-consuming operation to remove all the sand from the containers in which the sediments were dispersed and decanted. In our work the procedure has been facilitated by dispersing the sediments in glass tubes closed at both ends by rubber stoppers, and by decanting from a sedimentation tube, shown in the accompanying figure.

[1] This paper contains preliminary results of an investigation on the "Origin and Environment of Source Sediments," listed as Project 4 of American Petroleum Institute Research. Financial assistance in this work has been received from a research fund of the American Petroleum Institute donated by Mr. John D. Rockefeller. This fund is being administered by the institute with the cooperation of the central petroleum committee of the National Research Council. Manuscript received by the editor December 17, 1929.

The dispersing tubes are thirty-five millimeters in diameter and twenty-two centimeters long, and are closed by No. 7 solid rubber stoppers. Their capacity is about 160 cubic centimeters, which permits eighty cubic centimeters of water to be used in dispersing. The sedimentation tube consists of a glass tube which fits into a glass cup by a ground joint. The cup is three centimeters high and the tube nineteen centimeters, and both are made from forty-millimeter tubing. The ground joint is fifteen millimeters in length, and if the tube is twisted firmly into the cup the apparatus will not leak, even after standing full of water for several days. A hole in a wood block is used for a support, but the cup can be made with a base so that it will stand of itself.

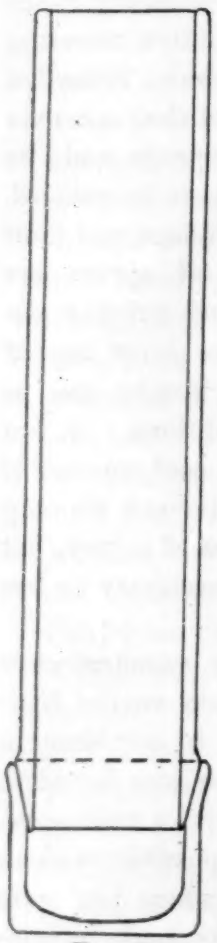

FIG. 1

The sediments are transferred from the dispersing tube to the sedimentation tube by removing one rubber stopper, inserting the dispersing tube into the inverted sedimentation tube, righting the whole apparatus, removing the other rubber stopper and washing with a stream of water. The silts and clays are decanted from the sedimentation tube, the cup in which the sands have collected is removed from the tube and the sands are readily washed out from the cup with a jet from a water bottle. The whole process is simple and very rapid. In fact, other processes involving decantation could probably be facilitated by a sedimentation tube of this type.

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STOCK CULTURES OF AMEBA

IN the course of experiments in this laboratory it has been necessary to maintain cultures of *Ameba proteus* in stock. The writer endeavored to find a medium that made requisite a minimum amount of attention. The effort in this direction met with considerable success, as appears below. In view of the wide use of *Ameba* of the *proteus* type in biological research and elementary instruction in biology, a culture medium that is simple, reproducible and extremely reliable will be of general interest. The medium used is as follows:

NaCl	0.1 gr.
KCl	0.004 gr.
$CaCl_2$	0.006 gr.
H_2O	1000 cc (glass distilled)

Two hundred to 250 cc of this solution is put into a finger-bowl or glass crystallizing dish of 8 or 10 cm diameter and to each of such dishes is added 4 or 5 grains of polished rice (any brand carried at the corner grocery is suitable). The cultures thus prepared are immediately seeded with fifty to one hundred amebas, covered with glass plates to prevent evaporation and entry of dust and then left, best in a dark cool place, to develop. Such cultures will produce a fine crop in from two to four weeks and so far in some thirty or forty cultures the writer has had only one or two failures. There are at present on the shelves of the laboratory, out of five that were set up as a test, three cultures one year old that have ample numbers of amebas; the other two died out in eleven months.

These five cultures during their existence have been deliberately neglected. No detritus was removed. Rice was added only when it was noticed that none was apparent in the culture. Water too has been added to compensate for evaporation with no attempt at regularity, say, on the average once a month. The temperature variation has been from 19 to 28° C.

In other words, the cultures have been subjected to as careless handling as if in the hands of a somewhat below par student assistant, but they have survived.

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SPECIAL ARTICLES

THE CHEMICAL CONTROL OF SPLENIC CONTRACTION

THE behavior of the spleen in responding to different physiological requirements and the fact that this response occurs only when its nerve supply is intact[1] suggests control by some center. At times when there is an emergency call for hemoglobin, as in asphyxia, hemorrhage or severe muscular exercise, contraction of the spleen throws into circulation a large number of red blood cells, as many as one third the total number in the body.[2] When the period of stress is over the spleen relaxes and the excess red blood cells are withdrawn from circulation. The

[1] E. A. Schäfer and B. Moore, *Journ. Physiol.*, 20 (1): 1–50, 1896.

[2] E. H. Starling, "Principles of Human Physiology," fifth edition, p. 820, 1930.

regulatory nature of the reaction and the character of the stimuli which set it off suggest at once a parallel with the action of the respiratory center. The stimuli acting on the respiratory center are (1) variation in the CO_2 pressure in the blood, (2) lack of O_2, (3) increase in the H-ion concentration of the blood, which in the normal animal is chiefly brought about through the presence of lactic acid. According to Gesell's now well-known theory, excitation of the cells in the respiratory center is the result of a shift in the equilibrium between these cells and their environment. It is evidently the change in the H-ion concentration within the cells which is the all-important internal factor, and because of its penetrating power CO_2 may be considered the chief environmental factor.

We have determined the effect on the spleen of these three stimuli: (1) increase in CO_2, (2) decrease of O_2 and (3) addition of lactic acid to the blood. For this purpose we have employed curarized, decapitate cats,[3] recording changes in the area of the spleen by tracing its outline on glass plates.[4] The advantage of such a preparation is that with the entire brain gone there can be no effect from emotional states, such as is seen in animals with exteriorized spleens,[5] or from muscular movements such as occur in decerebrate preparations,[4] both of which conditions would cause fairly rapid changes in the size of the spleen and confuse the issue. Furthermore, the administration of different gas mixtures is readily possible because of the necessity of supplying artificial respiration. This in itself is an added advantage because constant ventilation is assured regardless of the nature of the gas mixture, a condition which would certainly not obtain were the animal breathing on its own with medulla intact.

(1) A mixture of 4.8 per cent. CO_2 in O_2 caused a 10 per cent. reduction in the area of the spleen within five minutes (three experiments). There was no further significant change after ten minutes or even twenty minutes. Seven per cent. CO_2 in O_2 gave exactly the same results (five experiments). Eleven and eight tenths per cent. CO_2 in O_2 caused a 20 per cent. reduction in five minutes, and 30 per cent. within ten minutes, practically the maximum contraction or the post mortem condition (four experiments).

Similar results were obtained when the CO_2 was mixed with air instead of O_2. Two and one half per cent. CO_2 in air produced no significant change (two experiments). Five and six tenths per cent. CO_2 in air caused in five minutes a 10 per cent. reduction in the area of the spleen, with no further change after ten minutes or twenty minutes (three experiments). Ten and five tenths per cent. CO_2 in air caused a 14 per cent. reduction in five minutes (two experiments). Although fourteen different cats were used in the nineteen experiments, there was excellent agreement of the data and no experiment gave results contradictory to those of the others.

(2) Administration of 9 per cent. O_2 (three experiments) or even 5.1 per cent. O_2 (four experiments) in N_2 had no effect on the size of the spleen even after twenty minutes. The post mortem contraction following death by asphyxiation was normal in each case, therefore lack of response to lowered oxygen tension could not have been due to inability on the part of these spleens to respond to an adequate stimulus.

(3) Human blood may contain after severe muscular exercise as much as 0.12 per cent. lactic acid, or in exceptional cases 0.20 per cent.[6] If we consider the blood to constitute 7 per cent. of the body weight, then injection of 140 mgm lactic acid per kilo body weight would correspond to the exceptional cases, and injection of half this amount would correspond to the effect of severe exercise. The latter dose therefore should be sufficient to bring about contraction of the spleen if the lactic acid produced during muscular exercise is an adequate stimulus for such contraction. In order to affect the heart as little as possible and to prevent too great hemolysis of the blood by the sudden addition of a comparatively large volume of acid, we injected the requisite amount of 5 per cent. lactic acid sometimes directly into the femoral vein, and at others into a small side branch opening into the femoral vein, very slowly, *i.e.*, over a period of about two minutes. We found that when the larger dose was given the animal died immediately and the spleen contracted at once to its post mortem size (two experiments). On the other hand, when the lighter dose was given there was no change in the size of the spleen, and the preparation remained alive and in good condition (three experiments). In one case half an hour after the injection of 70 mgm of lactic acid per kilo, the size of the spleen having remained unchanged, 10.6 per cent. CO_2 in air was administered. The area of the spleen now diminished by 15 per cent. in 5 minutes, exactly as in the untreated preparation. In the other two cases the post mortem contraction was normal.

It should be emphasized that in this paper we are dealing only with the chemical stimuli affecting the adjustments of the spleen. Stimuli from the emotional (higher) nerve centers together with the action of epinephrine cause profound changes in the size of the spleen.[5] Similarly emotion and volition may

[3] S. F. Cook and J. M. D. Olmsted, *Am. Journ. Psysiol.*, 92 (1): 249–252, 1930.

[4] S. F. Cook and M. I. Rose, *ibid*, 92 (1): 240–248. 1930.

[5] J. Barcroft, *Journ. Physiol.*, 58 (4): 375–382, 1930.

[6] A. V. Hill, "Muscular Activity," p. 87, 1926.

override, at least temporarily, the action of the respiratory center.

The nervous mechanism controlling the action of the spleen in mobilizing reserves of hemoglobin responds therefore to only one of the three chemical stimuli which are effective for the respiratory center, *viz.*, increase in CO_2, but it is to be noted that this particular stimulus has been shown in the latter case to be by far the most important of the three. In fact, CO_2 is regarded as the "normal respiratory stimulant." In man, at any rate, the respiratory center responds to an addition of as little as 0.8 per cent. CO_2 to inspired air,[7] whereas in our experiments 2.5 per cent. CO_2 was ineffective on the spleen. It is perhaps to be expected that the control of the spleen should be less sensitive than the control of respiration, for the action of the spleen is an emergency one and is called into play under stress, whereas the respiratory center acts as a constant regulator and consequently must be able to respond to relatively small changes.

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THE CHEMICAL NATURE OF CYPRIDINA LUCIFERIN

THE nitrogen content of Cypridina luciferin is one of the most essential factors in deciding whether it is a protein or not. Luciferin isolated by my former method[1] contains about 4 per cent. of nitrogen, whereas luciferin isolated by my recent method[2] contains about 6 per cent. of nitrogen, as shown in Table I. This variability in quantity of nitrogen content is not clear, although the degree of purity of luciferin isolated may be supposed to be one cause. If so, the precipitation of luciferin with ammonium sulphate may act more selectively than when benzene dissolves it. Either of these amounts of nitrogen content is, however, too small for a protein. In this connection, it should be borne in mind that luciferin isolated by both my methods gives no protein color tests.

TABLE I

NITROGEN CONTENT OF CYPRIDINA LUCIFERIN*

Isolated by two methods		Former	Recent
One sample	Exp. 1	3.58 per cent.	5.84 per cent.
	" 2	3.74 " "	5.87 " "
	" 3	3.85 " "	6.04 " "
Average		3.72 " "	5.91 " "

* For all the determinations of nitrogen I am indebted to Mr. Shigeo Okido.

I have also found that Cypridina luciferin isolated by the two methods contains a large amount of phosphorus.[3] On the other hand, Witte's peptone, which chiefly consists of proteoses,[4] and Merck's peptone are found to contain phosphorus. In respect of phosphorus content, Harvey's belief[5] that Cypridina luciferin is a proteose or peptone seems to be favored. But this is not the case. Neither Witte's nor Merck's peptone is soluble in benzene, chloroform, ether, etc., as would be expected, whereas Cypridina luciferin is readily soluble in these solvents. These solubility relations of luciferin entirely refute the idea of Harvey.

The evidences from these triple experiments of nitrogen and phosphorus contents and solubility indicate that Cypridina luciferin is of a chemical nature similar in type to that of phospholipids and in particular to that of lecithins. The amount of nitrogen contained in luciferin isolated by my methods, however, is too much for a lecithin in the present state of purification.[6] We should, therefore, direct our research to the discovery of a pure luciferin, as pure as a phospholipid.

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[7] E. H. Starling, *op. cit.*, p. 875.

[1] S. Kanda, *Am. Journ. Physiol.*, 68: 435–443, 1924.

[2] S. Kanda, *Sci. Pap. Inst. Phys. Chem. Res.*, 10: 91–98, 1929; also *Chem. News*, 138: 247–248, 258–260, 1929.

[3] It was recently found that the luminous organs of the larva, pupa and adults of the Japanese firefly, *Luciola cruciata* (*vitticollis*), contain phosphorus.

[4] A. P. Mathews, "Text-book of Physiological Chemistry," 1927, p. 992.

[5] E. N. Harvey, *Journ. Gen. Physiol.*, 1: 269–293, 1919; *Bull. Nation. Res. Coun.*, 59: 50–62, 1927.

[6] Cypridina luciferin isolated by any methods contains some sulphur, which may be one of the impurities.